



**Testimony of the International Brotherhood of Electrical Workers**

**Presented by Paul Costello**

**Presented to:  
Public Safety and Security Committee**

**Tuesday February 10, 2009**

**Support for Raised Bill 788**

**An Act Requiring the State Building Code be Revised to Incorporate Revisions to the  
National Electrical Code**



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The following information is provided as substantiation for support of Senate Bill 788, An Act Requiring the State Building Code be Revised to Incorporate Revisions to the National Electrical Code.

- A June 2008 article from the New York Daily News tells the story of how a group of Policeman and Firefighters raised monies for funeral services for a two year old boy that was killed when he stuck a key into an electrical outlet. This is one example of many similar cases that led the National Electrical Code Making Panel to incorporate a change to require tamper resistant receptacles to be installed in homes starting with the 2008 NEC.
- Statistics from State Farm Insurance gathered from the Consumer Product Safety Committee (CPSC) outlining a study on the ease of removing plastic outlet protectors by children.
- Article from the International Electrical Inspectors Association (IAEI) January – February 2008 magazine on the expansion of safety in homes. The article details the principles of how an Arc Fault Circuit Interrupter (AFCI) operates and the protection they offer. The requirement for AFCI protection was expanded in the 2008 edition of the NEC.
- Examples of changes from the 1999 NEC to the 2008 edition (the edition year is on the bottom of the page) are used to illustrate how one individual article evolved. Article 406 the requirements for receptacles were created after moving the grouped information from article 410. The new material or changes are identified by either a vertical line in the margin or are shaded to make users aware of the changes that have occurred from one edition to the next. The next edition of the NEC will be in 2011. That edition will not make any references to the changes that were already covered in the 2008 NEC. This will be a problem for electricians that are required to take continuing education classes to maintain their licenses.
- Support from license holders attending the required continuing education for licensed electricians.

I respectfully ask for your support of Senate Bill 788, An Act Requiring the State Building Code be Revised to Incorporate Revisions to the National Electrical Code.

  
Paul Costello

JATC Director

**Testimony of the International Brotherhood of Electrical Workers  
Committee on Public Safety and Security  
Tuesday February 10, 2009**

Senators Stillman and Guglielmo, Representatives Dargan and Perillo, members of the Public Safety and Security Committee, my name is Paul Costello Director of Apprenticeship and Training for the International Brotherhood of Electrical Workers Local Union 90 and National Electrical Contractors Association Joint Apprenticeship Training Committee. I am a licensed electrical contractor E1-122305 and have been involved in the electrical industry for over 25 years. I am a member of the National Fire Protection Association (NFPA), an associate member of the International Association of Electrical Inspectors (IAEI), and other industry related associations. I am also privileged to be a principal member of NFPA code making panel 18 for the NEC.

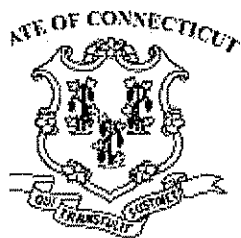
I am here to express our support of Senate Bill 788 An Act Requiring the State Building Code be Revised to Incorporate Revisions to the National Electrical Code. Without burdening you with all of the details of the code making process I would like to briefly express my concerns. The NEC is revised in its entirety every three years. There were 3688 proposals for changes to the 2008 NEC with an additional 2349 comments submitted for review, a large number of them resulting in major changes to the NEC. These important changes are vital to the safety of persons and property. As a principle member of the National Fire Protection Association (NFPA) code making panel appointed by the IBEW to represent 720,000 of its member. I was involved in one code change that will make every home in the state safer for our young children. A new requirement in the 2008 NEC will now require receptacles in a home to be tamper resistant. This new requirement will prevent a child from sticking an object such as keys, hair pins, and paper clips into the outlet and getting seriously burned or worse. This new requirement will provide a higher level of protection at a minimal cost. Unfortunately without the state adopting this edition in a timely manner this added level of safety will not be required in Connecticut. This is only one of hundreds of other new changes to the current code. I feel the citizens of Connecticut should be protected by the latest nationally recognized code in a timely manner and not wait till the next edition in 2011.

Other issues that arise are related to education. Apprentices and students in our Vocational Technical Schools in Connecticut and Apprenticeship Programs are taught with curriculum that is based on the most recent editions of the National Electrical Code. Textbook publishers print their text to reflect the latest edition of the NEC. As the new edition of the NEC is published it becomes more difficult to purchase older editions. Since 2005, electricians have been required to complete continuing education in order to renew their licenses. I am a strong supporter of the requirement. I am also an instructor approved by the Department of Consumer Protection. Each year I have trained over 1,200 of the approximately 13,000 licensed electricians in the state. All have expressed their frustration when the codes are not adopted or have been amended when they become available for adoption by the states. By not adopting the 2008 providers of continuing education will not be conveying the changes made in the 2008 NEC. When the next edition is adopted in 2011 it will not identify or reference any of the previous changes. This I feel is serious safety concern for all. I could only imagine how many lives would be lost if the same reasoning was applied to the decision of whether or not we should delay requiring seat belts in cars.

I feel that the most recent edition of the NEC should be adopted to protect the "safeguarding of persons and property from hazards arising from the use of electricity" (Article 90.1(A) 2008 NEC). I urge you to support Senate Bill 788.

Respectfully,

  
Paul Costello  
JATC Director



General Assembly  
January Session, 2009

**Raised Bill No. 788**

LCO No. 2757

\*02757 \_\_\_\_\_ PS \*

ferred to Committee on Public Safety and Security

roduced by:

S)

**A ACT REQUIRING THE STATE BUILDING CODE BE REVISED TO INCORPORATE REVISIONS TO  
IE NATIONAL ELECTRICAL CODE.**

it enacted by the Senate and House of Representatives in General Assembly convened:

ction 1. Subsection (a) of section 29-252 of the general statutes is repealed and the following is  
bstituted in lieu thereof (*Effective October 1, 2009*):

As used in this subsection, "geotechnical" means any geological condition, such as soil and subsurface  
il conditions, which may affect the structural characteristics of a building or structure. The State Building  
psector and the Codes and Standards Committee shall, jointly, with the approval of the Commissioner of  
blic Safety, adopt and administer a State Building Code based on a nationally recognized model  
ilding code for the purpose of regulating the design, construction and use of buildings or structures to  
erected and the alteration of buildings or structures already erected and make such amendments thereto  
they, from time to time, deem necessary or desirable. Such amendments shall be limited to  
ministrative matters, geotechnical and weather-related portions of said code, amendments to said code  
ecessitated by a provision of the general statutes and any other matter which, based on substantial  
idence, necessitates an amendment to said code. The code shall be revised (1) not later than January 1,  
05, and thereafter as deemed necessary to incorporate any subsequent revisions to the code not later  
in eighteen months following the date of first publication of said subsequent revisions to the code; and  
not later than January 1, 2009, to incorporate revisions to the National Electrical Code adopted by the  
ational Fire Protection Association, and thereafter as deemed necessary to incorporate any subsequent  
visions, but in no event later than one year following the date of first publication of any subsequent  
visions to the National Electrical Code. The purpose of said Building Code shall also include, but not be  
imited to, promoting and ensuring that such buildings and structures are designed and constructed in  
h a manner as to conserve energy and, wherever practicable, facilitate the use of renewable energy  
ources. Said Building Code includes any code, rule or regulation incorporated therein by reference.

his act shall take effect as follows and shall amend the following  
ctions:

ction 1	October 1, 2009	29-252(a)
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***Statement of Purpose:***

To require the State Building Code to be updated to incorporate revisions to the National Electrical Code, and to require the state to continually adopt such revisions.

*[Proposed deletions are enclosed in brackets. Proposed additions are indicated by underline, except that when the entire text of a bill or resolution or a section of a bill or resolution is new, it is not underlined.]*

## Cop rallies nabe after death of boy, 2; just wanted to help his family

uesday, June 24th 2008, 12:23 AM

he electric outlet had no safety plug to keep 2-year-old Josian Garcia Camacho from sticking in a key as any kid his age might.

he Bronx boy was beyond saving when firefighters and paramedics arrived last Tuesday night.

he 40th Precinct stationhouse is directly next door and the next day Community Affairs Police Officer Dimas Cortez appeared at the family's fifth floor apartment.

said, "I'm just here to see how I can help you," Cortez recalls.

he dead boy's father held out a paper on which a local funeral home had written an estimate of \$4,700. This was about \$4,700 more than the grieving family could manage. Cortez understood they were destitute as well as devastated.

ortez told the father to give him a little time. The cop went to another funeral home, the La Paz on 149th St. La Paz immediately agreed to provide the coffin and the funeral gratis.

They opened their arms and said, "Whatever you need for this family," Cortez remembers.

here remained the \$350 cost of flying the boy to his native Mexico and the \$250 for burial there. Cortez conferred at the stationhouse with the PBA delegate, Police Officer Brian McGuckin.

Ve said, "We have to do something," Cortez recalls.

ven cops who are feeling a pinch supporting their families reached into their pockets. A single roll call kicked in \$700. The cops apt giving and the total collection was \$1,740.

they GAVE," McGuckin says. "It was definitely the whole command."

ortez and McGuckin visited all three firehouses in the precinct. The firefighters were just as quick to kick in.

he wake was on Friday, and a fire lieutenant presented the grieving family with envelopes containing \$750 in addition to what the cops raised to help them through the bleak days ahead.

he boy lay in his coffin clad in a white suit and shoes that Cortez had bought at Angel's clothing store.

ll my son would talk about is cops and firemen," the mother told Cortez in Spanish.

ve of the fire rigs that once thrilled the boy parked outside La Paz as firefighters knelt two at a time before the tiny coffin.

he cops did the same and the 40th Precinct provided a floral arrangement in addition to those donated by a local florist. The legendary battle of the badges seemed just so much bunk.

7 p.m., everyone joined in prayer led by the Rev. John Grange. The family brought the cops' flowers home and set them before a makeshift altar that included photos of the boy, religious figures, a candle and a slice of watermelon.

he flowers still smelled fresh and the candle was still flickering when I visited the apartment Monday. I gazed at a photomontage of Josian climbing rocks.

the park," a male relative said.

female relative came out with the youngest of the three surviving children, a smiling 4-month-old named Yahir.

boy," the woman said.

## Cop rallies nabe after death of boy, 2; just wanted to help his family

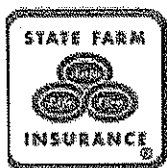
At the stationhouse next door, Cortez was busy contacting companies that might donate safety outlet plugs to be distributed at the big fair on Third Ave. on Sunday. A number of his friends had urged him to call the media and get some credit for himself and the 40th Precinct.

"I said, 'No, we know in our hearts what we of the 4-0 and the firemen did,' " he recalled

In fact, you would not be reading this story now if a firefighter had not called me to marvel at this community affairs cop and what his comrades had done.

"We aren't looking for recognition," Cortez said. "We were just looking to help."

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## Children and Electrical Outlets

Electrical outlets are usually installed at a height at or near a child's eye level, and a child's curiosity can draw them to explore, making electrical outlets a source of worry for many parents.

The chance of electrocution is small, but the results can be devastating. According to a 1994 estimate of electrocutions released by the Consumer Product Safety Commission (CPSC), there were 890 deaths in 1984, decreasing to 560 in 1994. (These figures include all age groups and count only fatalities and not shocks and injuries.)

In another study conducted in 1997, the CPSC found:

- 86 percent of reported injuries involved children 1 to 4 years old
- The highest frequency of home electrical injuries occurred at mealtimes
- The most commonly used foreign objects inserted into outlets were keys and hairpins

This indicates that many home electrocution and shock injuries involve unsupervised children. There are simple measures that can be taken to avoid injury or death to a child.

### Plastic outlet protectors

Most of us are familiar with plastic outlet protectors. The prongs fit directly into the outlet holes, preventing the insertion of foreign objects. But many parents say they feel a little uneasy about the effectiveness of these devices. A study of 37 children conducted in 1997 by the Biokinetics Research Laboratory of Temple University seems to confirm their reservations:

- 47 percent of 4-year-olds and 31 percent of 2-year-olds could remove protectors with a round, flat face and two prongs
- 47 percent of 4-year-olds and 18 percent of 2-year-olds could remove protectors with a 3/16-inch thick oval face and a tapered side
- 100 percent of 2- and 4-year-olds could remove protectors with a 1/16-inch thick oval face and a flat side

### Child tamper-resistant outlets

A few electrical device manufacturers make electrical outlets that are intended to prevent a child from inserting something into the outlet holes. They look just like any other outlet, but behind the face of the receptacle are plastic shutters.

These shutters are designed to remain closed until a plug is inserted. When something is inserted into both vertical outlet holes at the same time, the interior plastic shutters open. Its safety is premised on the fact that most young children will not try to stick two objects into the two vertical outlet holes at the same time.

These outlets cost \$4 to \$6 each, as compared to \$1 to \$3 each for a typical

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## Children and electrical outlets

electrical outlet receptacle. They require no additional labor to install than typical outlet receptacles. These outlets are available through your local electrical supply store or your electrician.

### Child tamper-resistant outlet face covers

Electrical outlet receptacle covers have faces that swivel or slide over the outlet holes. Some are intended as replacement face covers; others install over existing outlet face covers.

The electrical outlet face covers cost anywhere from \$3 to \$6 each. Those that replace the existing outlet face cover can be bought from your local electrical supply store or your electrician. The after-market faceplate that fits over the existing outlet faceplate is sold through baby product magazines, discount stores and building supply stores.

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# Expanding HOME SAFETY with AFCIs



by Gerard Winstanley

Smoke alarms, fire extinguishers, emergency escape ladders—these are all proven methods for making a quick and safe escape from a fire in the home. However, in addition to these measures, proven technology exists to prevent fires from starting in the first place. Arc-fault circuit interrupters (AFCIs)—the next generation in circuit breaker technology—are one such life-saving tool that should be considered by home owners and home builders alike.

In fact, the *National Electrical Code (NEC)*, which contains a requirement for AFCIs since the 1999 edition, has since strengthened its support in the technology. Begin-

ning in January 2008, the next edition of the *NEC* will take effect, expanding the AFCI requirement from only in the bedroom to now being required in occupied areas, such as living rooms, dining rooms and other areas where the technology may help improve the safety of the home.

Many prominent experts in the electrical and home building community believe this expanded requirement will have a significant, positive impact on homeowner safety, and decrease the number of lives lost and injuries that occur in home electrical fires.

Advanced AFCI technology was developed in response to an identified problem in the electrical system

opment (HUD)<sup>3</sup> lists AFCI technology as a key device in preventing burns and fire-related injuries.

### A Technological Leap Forward

Unlike a conventional circuit breaker, which detects overloads and short circuits, an AFCI utilizes advanced electronic technology to “sense” different arcing conditions. Specifically, AFCIs provide increased protection by detecting a condition known as an *arc fault*, which is defined by Underwriters Laboratories Inc. (UL), an independent, product-safety certification organization, as an unintentional arcing condition in a circuit.

Common household items, such as a motor-driven vacuum cleaner and the motor in a furnace, naturally create arcs when they are operating. These conditions are considered normal arcs, which can also occur when a light switch is turned off.

Arc faults, however, occur from damaged wiring, overheated or stressed electrical cords, worn electrical insulation, wires and/or cords in contact with vibrating metal, damaged electrical appliances and more. This potentially dangerous condition creates high-intensity heat—which may exceed 10,000 degrees Fahrenheit—resulting in burning particles that can easily ignite surrounding material, such as wood framing or insulation.

AFCIs are designed to recognize when arc faults occur and automatically shut the circuit down before it becomes a fire hazard. Manufacturers of AFCIs test for the hundreds of possible operating conditions, and design each AFCI to constantly discern between normal and dangerous arcs.

### Types of Arc-Fault Circuit Interrupters

AFCIs are intended to mitigate the effects of arc faults by de-energizing the circuit when an arc fault is detected. In 1996, Underwriters Laboratories Inc. published UL 1699—the recognized national standard for AFCIs.

UL 1699 covers a wide variety of conditions that may affect AFCI performance, including humidity, unwanted tripping, abnormal operation, voltage surges and more. Each type of AFCI is required to comply with UL 1699.

Two types of AFCIs are available—branch/feeder and combination. Both types are intended to be installed at the origin of a branch circuit or feeder, such as a panelboard or load center. The branch/feeder AFCI detects parallel arcing faults, which can occur line-to-line, line-to-neutral and line-to-ground.



Photo 1. The Consumer Product Safety Commission (CPSC) estimates that AFCI circuit breakers could prevent 50–75 percent of electrical fires, and the U.S. Department of Housing and Urban Development lists the technology as a key device in preventing burns and fire-related injuries.

causing home fires. According to the latest reports from the United States Fire Administration (USFA), electrical problems spark an estimated 67,800 residential fires every year. These fires are responsible for the deaths of 485 innocent victims, approximately 2,300 injuries and more than \$868 million in residential property damage.<sup>1</sup>

The United States Consumer Products Safety Commission (CPSC) estimates that AFCI technology could prevent more than 50 percent of these types of fires,<sup>2</sup> and the U.S. Department of Housing and Urban Development

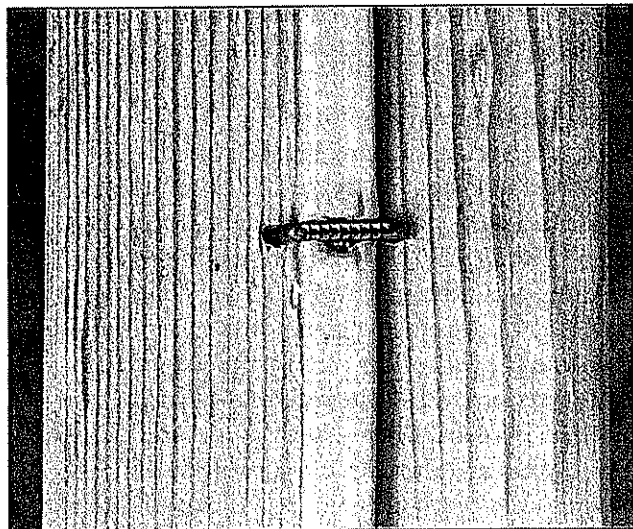


Photo 2

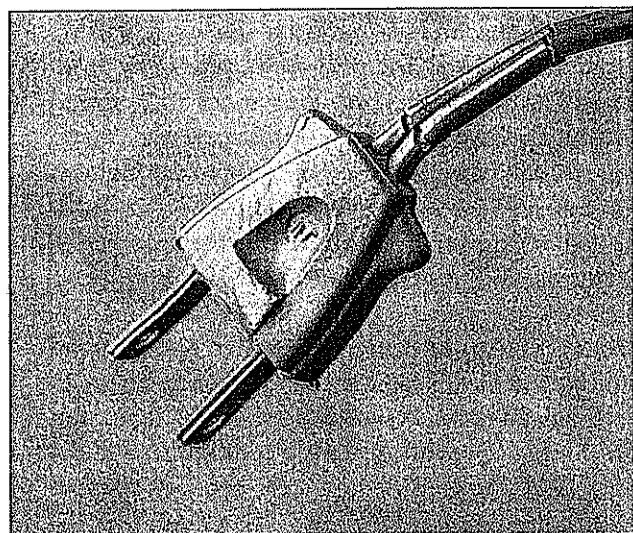


Photo 3

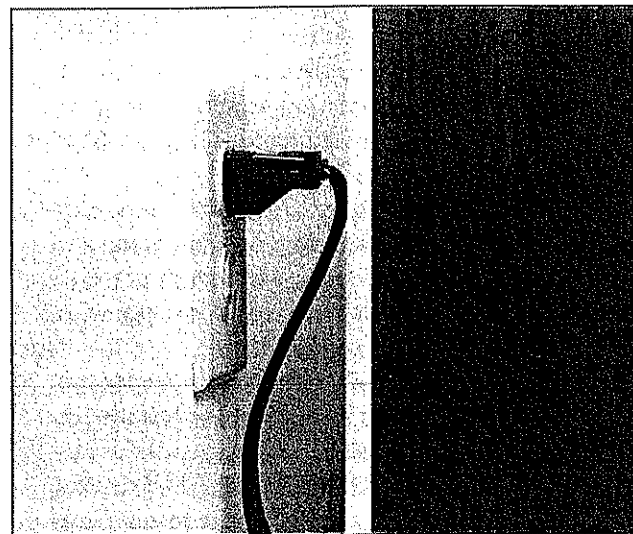


Photo 4

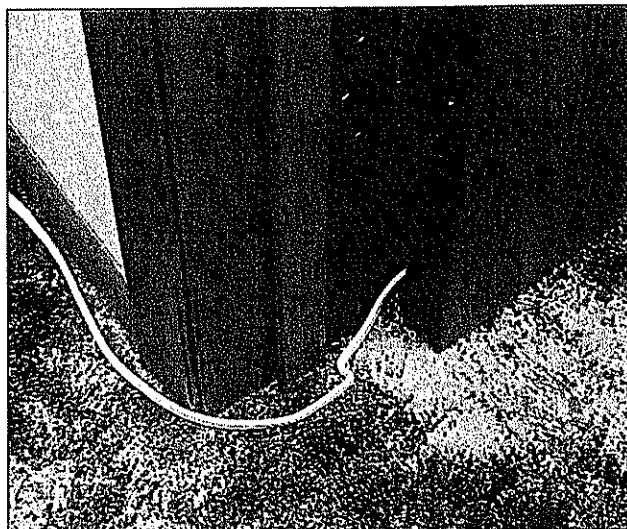


Photo 5

The combination AFCI takes the technology one step further and detects not only parallel arcing, but also series arcing, which is useful in identifying lower-level arcing in both branch circuits and power supply cords. A series arc can occur when the conductor in series with the load is unintentionally broken. Effective January 1, 2008, combination AFCI protection will be required in all new homes.

#### Nationally Recognized Safety Device

As previously mentioned, the *National Electrical Code* specifically defines and mandates the installation of AFCIs.

Research in the arc fault area began in the late 1980s and early 1990s when the CPSC identified a concern in residential fires that were a result of a problem in the electrical system. It was discovered that a large number of these fires were estimated to be in branch-circuit wiring systems.

The concept of AFCIs gained more momentum when a code proposal was made to *NEC-1993* to change the instantaneous trip levels of 15 A and 20 A circuit breakers. The Electronic Industries Association (EIA) studied the issue of electrical fires and determined that additional protection against arcing faults needed to be addressed. This proposal first attempted to call for added protection by requiring that instantaneous trip levels of a circuit breaker be reduced from a range of 120 to 150 amperes down to 85 amperes. However, it became clear that the lowering of those levels below some of the minimums already available on the market would result in significant unwanted tripping due to normal inrush currents.

These early studies and code efforts led to the first proposals to require AFCIs, which were made during the development of *NEC-1999*. NEC Code-Making

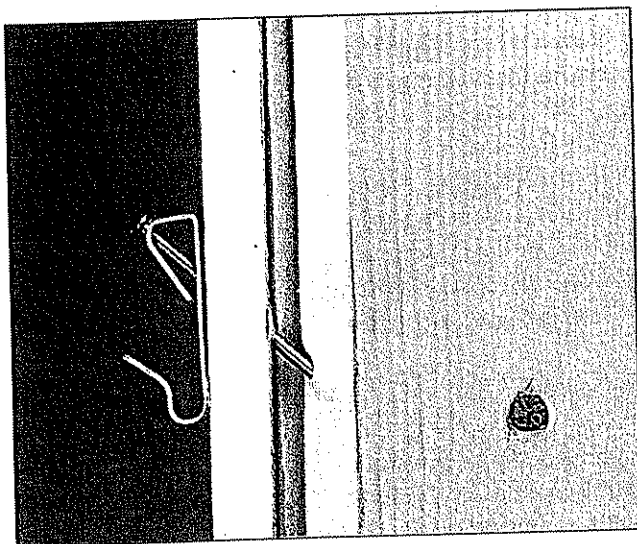


Photo 6

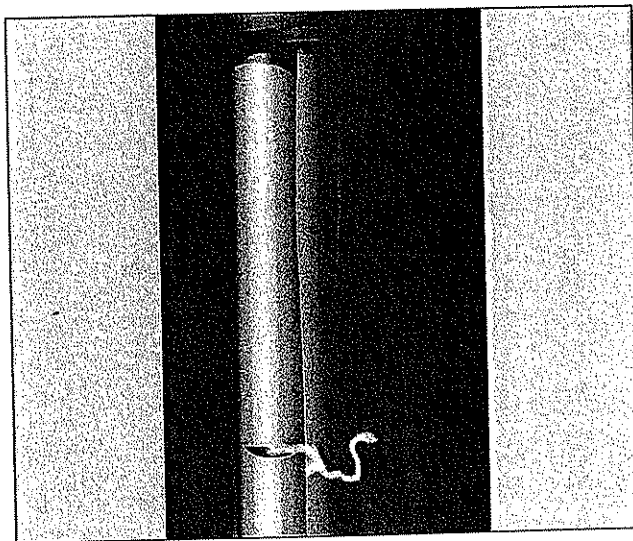
**Photos 2-6. AFCIs provide increased protection by detecting a condition known as an arc fault, which can occur from damaged wiring, overheated or stressed electrical codes, worn electrical insulation, wires and/or cords in contact with vibrating metal, damaged electrical appliances and more.**

Panel 2 (CMP-2) reviewed many proposals, ranging from protecting the entire residence to the protection of the living and sleeping areas. The panel also heard numerous presentations from both sides of the issue. After extensive data analysis and discussion, the code-making panel concluded that AFCI protection should be required in branch circuits that supply receptacle outlets in bedrooms.

The first requirement for AFCIs appeared in *NEC*-1999 under Section 210.12 and subsequent editions have further upgraded the requirements for its use. The 1999 edition, which became effective in 2002, required that dwelling unit bedrooms have AFCIs installed to protect only those branch circuits that supply 125-volt, single-phase, 15- and 20-ampere receptacle outlets.

After further research and analysis of the technology and its potential safety benefits, the 2002 edition updated Section 210.12 and expanded the requirement for AFCIs to include all bedroom circuits, including those that supply lighting fixtures, smoke alarms, and other equipment. Section 210.12 was again revised in 2005 to provide for a technology upgrade to the combination type of AFCIs.

While previous generations of AFCIs detected parallel arcing, the combination AFCI could also detect series arcing, and at lower levels. *NEC*-2008, which was published in September, takes safety a step further by requiring that all new home construction install combination AFCIs on circuits not only in bedrooms but also in additional living areas in the home.



**Figure 1. Branch/feeder AFCIs provide protection through the detection of parallel arcing faults that can occur line-to-line, line-to-neutral and line-to-ground.**

Since the beginning of its evolution in the *NEC*, several prominent organizations in the United States have come out in support of the technology. In addition to the CPSC and HUD, the expanded requirements have the support of the National Electrical Manufacturers Association (NEMA), National Association of State Fire Marshals, National Electrical Contractors Association (NECA), Electrical Safety Foundation International, as well as many home inspectors and fire personnel, who see firsthand the significant damage electrical fires cause.

### Small Cost Equals Big Payoff

As with any change in the required protection for the electrical system, there have been many discussions and deliberations both for and against arc-fault protection being a part of the *NEC*.

Some have argued that the cost of the AFCI is higher than a standard circuit breaker and, as such, it costs too much to provide the increased protection. Others have argued that since it is a relatively new type of protection, AFCIs do not have the history on which to base a decision as to whether to support it or not.

While there is an additional cost to upgrading new homes from standard circuit breakers to AFCI technology, this cost increase is small. One could argue that AFCIs cost much less than some "non-safety" related upgrades that are typical in a new home, such as expensive kitchen cabinets and countertops. In fact, the cost to homeowners to have builders add additional protection to the home—in the form of AFCIs—is relatively insignificant when compared to the risk of death and injury caused by electrical fires.

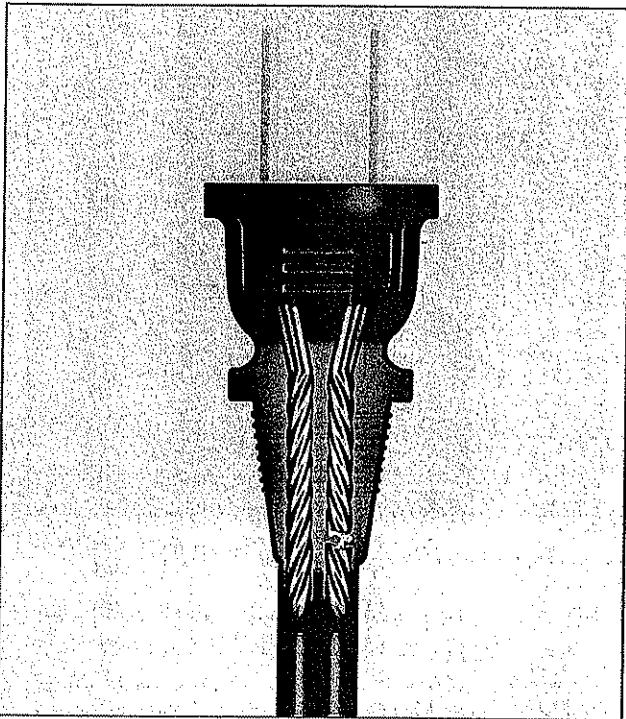


Figure 2. The combination type AFCI takes technology a step further and detects not only parallel arcing, but also series arcing, which is useful in identifying lower-level arcing in both branch circuits and power supply cords.

A quick survey of hardware stores and do-it-yourself home centers (e.g., Home Depot, Lowe's) found AFCIs priced in the \$30–\$35 range and standard circuit breakers priced from \$2–\$4. Using the high-end price of \$35, the cost differential between AFCIs and the standard circuit breaker is approximately \$31–\$33. According to a September 2006 article in *Electrical Wholesaling* magazine, the average cost of a 2,500 sq. ft. house is \$192,846;<sup>4</sup> and with the average num-

ber of circuits requiring AFCIs being 12, this equates to an approximate cost increase of \$372 – \$396 to the homeowner, or one-fifth of one percent of the national average cost of that 2,500 sq. ft. home.

When comparing these figures to the hundreds of millions of dollars lost in electrical fires each year, saving a human life or preventing injury or property loss is well worth the cost of additional protection in the home, and certainly well worth the investment.

### The Bottom Line

Applying technology to improve the electrical safety of the home is a wise investment for both the homeowner and the community at large. Reducing fires of electrical origin and saving lives is an important responsibility of the entire construction and regulatory community. The irreplaceable value placed on human life taken and heavy toll on property destroyed in electrical fires provides a clear indication of the need for homebuilders and contractors to provide consumers with the safest home possible.

Educating homebuyers on the latest in home protection devices beyond the smoke alarm, emergency ladders, and similar “after-the-fact” safety devices is the first step in preventing electrical fires. In addition, new homeowners should know what options are available in the way of home safety, and are encouraged to ask their builder or electrician about the life-saving capabilities of AFCIs. With the potential to cut the number of electrical fires that occur each year in half, AFCI technology should not be overlooked. //

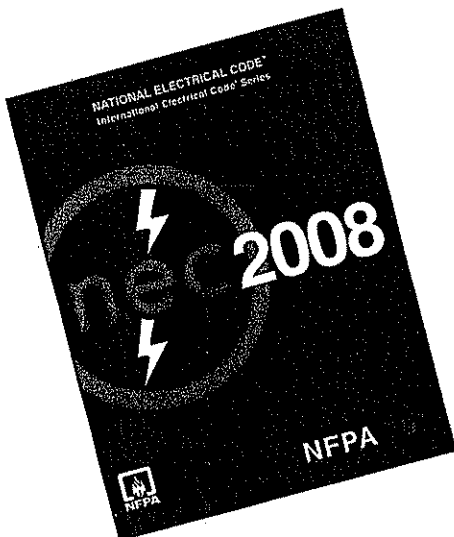


Figure 3. Section 210.12 of the 2008 *National Electrical Code* requires combination AFCIs on circuits not only in bedrooms but also in additional living areas in the home.

### References

- <sup>1</sup> United States Fire Administration. *On the Safety Circuit: A Fact sheet on Home Electrical Fire Prevention*. 2006.
- <sup>2</sup> United States Consumer Products Safety Commission. *Economic Considerations – AFCI Replacements*. Memorandum, March 2003.
- <sup>3</sup> United States Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control. *Healthy Homes Issues: Injury Hazards*, Version 3. March 2006.
- <sup>4</sup> *Electrical Wholesaling*. Home builders report most recent quarterly sales down from a year ago. September 2006.



Gerard Winstanley is a technical program manager with the National Electrical Manufacturers Association's (NEMA's) Low-Voltage Distribution Equipment section. Winstanley has more than eight years of experience in the development of national and international electrical codes and standards. For more information about arc-fault circuit interrupters, visit [www.AFCIsafety.org](http://www.AFCIsafety.org), an educational Web site devoted to educating consumers and industry professionals about the important home safety device.

interrupts the electrical connection to the center contact. The switching mechanism shall also be permitted to interrupt the electrical connection to the screw shell if the connection to the center contact is simultaneously interrupted.

### K. Lamps and Auxiliary Equipment

**410-53. Bases, Incandescent Lamps.** An incandescent lamp for general use on lighting branch circuits shall not be equipped with a medium base if rated over 300 watts, nor with a mogul base if rated over 1500 watts. Special bases or other devices shall be used for over 1500 watts.

### 410-54. Electric-Discharge Lamp Auxiliary Equipment.

(a) **Enclosures.** Auxiliary equipment for electric-discharge lamps shall be enclosed in noncombustible cases and treated as sources of heat.

(b) **Switching.** Where supplied by the ungrounded conductors of a circuit, the switching device of auxiliary equipment shall simultaneously disconnect all conductors.

### L. Receptacles, Cord Connectors, and Attachment Plugs (Caps)

#### 410-56. Rating and Type.

(a) **Receptacles.** Receptacles installed for the attachment of portable cords shall be rated at not less than 15 amperes, 125 volts, or 15 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

(b) **CO/ALR Receptacles.** Receptacles rated 20 amperes or less and directly connected to aluminum conductors shall be marked CO/ALR.

(c) **Isolated Ground Receptacles.** Receptacles intended for the reduction of electrical noise (electromagnetic interference) as permitted in Section 250-146(d) shall be identified by an orange triangle located on the face of the receptacle. Receptacles so identified shall be used only with grounding conductors that are isolated in accordance with Section 250-146(d). Isolated ground receptacles installed in nonmetallic boxes shall be covered with a nonmetallic faceplate.

*Exception: Where an isolated ground receptacle is installed in a nonmetallic box, a metal faceplate shall be permitted if the box contains a feature or accessory that permits the effective grounding of the faceplate.*

(d) **Faceplates.** Metal faceplates shall be of ferrous metal not less than 0.030 in. (0.762 mm) in thickness or of nonferrous metal not less than 0.040 in. (1.016 mm) in thickness.

Metal faceplates shall be grounded. Faceplates of insulating material shall be noncombustible and not less than 0.10 in. (2.54 mm) in thickness but shall be permitted to be less than 0.10 in. (2.54 mm) in thickness if formed or reinforced to provide adequate mechanical strength.

(e) **Position of Receptacle Faces.** After installation, receptacle faces shall be flush with or project from faceplates of insulating material and shall project a minimum of 0.015 in. (0.381 mm) from metal faceplates. Faceplates shall be installed so as to completely cover the opening and seat against the mounting surface.

#### (f) Receptacle Mounting.

(1) Receptacles mounted in boxes that are set-back of the wall surface, as permitted in Section 370-20, shall be installed so that the mounting yoke or strap of the receptacle is held rigidly at the surface of the wall.

(2) Receptacles mounted in boxes that are flush with the wall surface or project therefrom shall be installed so that the mounting yoke or strap of the receptacle is seated against the box or raised box cover.

(3) **Receptacles Mounted on Covers.** Receptacles mounted to and supported by a cover shall be secured by more than one screw or shall be a device assembly or box cover listed and identified for securing by a single screw.

(g) **Attachment Plugs.** All 15- and 20-ampere attachment plugs and connectors shall be constructed so that there are no exposed current-carrying parts except the prongs, blades, or pins. The cover for wire terminations shall be a part, which is essential for the operation of an attachment plug or connector (dead-front construction). Attachment plugs shall be installed so that their prongs, blades, or pins are not energized unless inserted into an energized receptacle. No receptacle shall be installed so as to require an energized attachment plug as its source of supply.

(h) **Attachment Plug Ejector Mechanisms.** Attachment plug ejector mechanisms shall not adversely affect engagement of the blades of the attachment plug with the contacts of the receptacle.

(i) **Noninterchangeability.** Receptacles, cord connectors, and attachment plugs shall be constructed so that receptacle or cord connectors will not accept an attachment plug with a different voltage or current rating than that for which the device is intended; however, a 20-ampere T-slot receptacle or cord connector shall be permitted to accept a 15-ampere attachment plug of the same voltage rating. Nongrounding-type receptacles and connectors shall not accept grounding-type attachment plugs.

**410-57. Receptacles in Damp or Wet Locations.**

(a) **Damp Locations.** A receptacle installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

An installation suitable for wet locations shall also be considered suitable for damp locations.

A receptacle shall be considered to be in a location protected from the weather where located under roofed open porches, canopies, marquees, and the like, and will not be subjected to a beating rain or water runoff.

**(b) Wet Locations.**

(1) A receptacle installed in a wet location where the product intended to be plugged into it is not attended while in use (e.g., sprinkler system controllers, landscape lighting, holiday lights, etc.) shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(2) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (e.g., portable tools, etc.) shall have an enclosure that is weatherproof when the attachment plug cap is removed.

(c) **Bathtub and Shower Space.** A receptacle shall not be installed within a bathtub or shower space.

(d) **Protection for Floor Receptacles.** Standpipes of floor receptacles shall allow floor-cleaning equipment to be operated without damage to receptacles.

(e) **Flush Mounting with Faceplate.** The enclosure for a receptacle installed in an outlet box flush-mounted on a wall surface shall be made weatherproof by means of a weatherproof faceplate assembly that provides a watertight connection between the plate and the wall surface.

(f) **Installation.** A receptacle outlet installed outdoors shall be located so that water accumulation is not likely to touch the outlet cover or plate.

**410-58. Grounding-Type Receptacles, Adapters, Cord Connectors, and Attachment Plugs.**

(a) **Grounding Poles.** Grounding-type receptacles, cord connectors, and attachment plugs shall be provided with one fixed grounding pole in addition to the circuit poles. The grounding contacting pole of grounding-type plug-in ground-fault circuit interrupters shall be permitted to be of the movable, self-restoring type on circuits operating at not over 150 volts between and to conductors nor over 150 volts between any conductor and ground.

(b) **Grounding-Pole Identification.** Grounding-type receptacles, adapters, cord connections, and attachment plugs

shall have a means for connection of a grounding conductor to the grounding pole.

A terminal for connection to the grounding pole shall be designated by one of the following.

- (1) A green-colored hexagonal-headed or shaped terminal screw or nut, not readily removable.
- (2) A green-colored pressure wire connector body (a wire barrel).
- (3) A similar green-colored connection device, in the case of adapters. The grounding terminal of a grounding adapter shall be a green-colored rigid ear, lug, or similar device. The grounding connection shall be designed so that it cannot make contact with current-carrying parts of the receptacle, adapter, or attachment plug. The adapter shall be polarized.
- (4) If the terminal for the equipment grounding conductor is not visible, the conductor entrance hole shall be marked with the word "green" or "ground," the letters "G" or "GR" or the grounding symbol, as shown in Figure 410-58(b)(4), or otherwise identified by a distinctive green color. If the terminal for the equipment grounding conductor is readily removable, the area adjacent to the terminal shall be similarly marked.



Figure 410-58(b)(4). Grounding symbol.

(c) **Grounding Terminal Use.** A grounding terminal or grounding-type device shall not be used for purposes other than grounding.

(d) **Grounding-Pole Requirements.** Grounding-type attachment plugs and mating cord connectors and receptacles shall be designed so that the grounding connection is made before the current-carrying connections. Grounding-type devices shall be designed so grounding poles of attachment plugs cannot be brought into contact with current-carrying parts of receptacles or cord connectors.

(e) **Use.** Grounding-type attachment plugs shall be used only with a cord having an equipment grounding conductor.

**M. Special Provisions for Flush and Recessed Fixtures**

**410-64. General.** Fixtures installed in recessed cavities in walls or ceilings shall comply with Sections 410-65 through 410-72.

**410-65. Temperature.**

(a) **Combustible Material.** Fixtures shall be installed so that adjacent combustible material will not be subjected to temperatures in excess of 90°C (194°F).

- (2) Inductive loads not exceeding 50 percent of the ampere rating of the switch at the applied voltage. Switches rated in horsepower are suitable for controlling motor loads within their rating at the voltage applied.
- (3) Tungsten-filament lamp loads not exceeding the ampere rating of the switch at the applied voltage if T-rated.

(C) **CO/ALR Snap Switches.** Snap switches rated 20 amperes or less directly connected to aluminum conductors shall be listed and marked CO/ALR.

(D) **Alternating-Current Specific-Use Snap Switches Rated for 347 Volts.** Snap switches rated 347 volts ac shall be listed and shall be used only for controlling the following.

(1) **Noninductive Loads.** Noninductive loads other than tungsten-filament lamps not exceeding the ampere and voltage ratings of the switch.

(2) **Inductive Loads.** Inductive loads not exceeding the ampere and voltage ratings of the switch. Where particular load characteristics or limitations are specified as a condition of the listing, those restrictions shall be observed regardless of the ampere rating of the load.

The ampere rating of the switch shall not be less than 15 amperes at a voltage rating of 347 volts ac. Flush-type snap switches rated 347 volts ac shall not be readily interchangeable in box mounting with switches identified in 404.14(A) and (B).

(E) **Dimmer Switches.** General-use dimmer switches shall be used only to control permanently installed incandescent luminaires (lighting fixtures) unless listed for the control of other loads and installed accordingly.

## II. Construction Specifications

### 404.15 Marking.

(A) **Ratings.** Switches shall be marked with the current, voltage, and, if horsepower rated, the maximum rating for which they are designed.

(B) **Off Indication.** Where in the off position, a switching device with a marked OFF position shall completely disconnect all ungrounded conductors to the load it controls.

**404.16 600-Volt Knife Switches.** Auxiliary contacts of a renewable or quick-break type or the equivalent shall be provided on all knife switches rated 600 volts and designed for use in breaking current over 200 amperes.

**404.17 Fused Switches.** A fused switch shall not have fuses in parallel except as permitted in 240.8.

**404.18 Wire-Bending Space.** The wire-bending space required by 404.3 shall meet Table 312.6(B) spacings to the enclosure wall opposite the line and load terminals.

*new section*

## ARTICLE 406 Receptacles, Cord Connectors, and Attachment Plugs (Caps)

**406.1 Scope.** This article covers the rating, type, and installation of receptacles, cord connectors, and attachment plugs (cord caps).

### 406.2 Receptacle Rating and Type.

(A) **Receptacles.** Receptacles shall be listed for the purpose and marked with the manufacturer's name or identification and voltage and ampere ratings.

(B) **Rating.** Receptacles and cord connectors shall be rated not less than 15 amperes, 125 volts, or 15 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

FPN: See 210.21(B) for receptacle ratings where installed on branch circuits.

(C) **Receptacles for Aluminum Conductors.** Receptacles rated 20 amperes or less and designed for the direct connection of aluminum conductors shall be marked CO/ALR.

(D) **Isolated Ground Receptacles.** Receptacles incorporating an isolated grounding connection intended for the reduction of electrical noise (electromagnetic interference) as permitted in 250.146(D) shall be identified by an orange triangle located on the face of the receptacle.

(1) Receptacles so identified shall be used only with grounding conductors that are isolated in accordance with 250.146(D).

(2) Isolated ground receptacles installed in nonmetallic boxes shall be covered with a nonmetallic faceplate.

*Exception: Where an isolated ground receptacle is installed in a nonmetallic box, a metal faceplate shall be permitted if the box contains a feature or accessory that permits the effective grounding of the faceplate.*

**406.3 General Installation Requirements.** Receptacle outlets shall be located in branch circuits in accordance with Part III of Article 210. General installation requirements shall be in accordance with 406.3(A) through (F).

**(A) Grounding Type.** Receptacles installed on 15- and 20-ampere branch circuits shall be of the grounding type. Grounding-type receptacles shall be installed only on circuits of the voltage class and current for which they are rated, except as provided in Tables 210.21(B)(2) and (B)(3).

*Exception: Nongrounding-type receptacles installed in accordance with 406.3(D).*

**(B) To Be Grounded.** Receptacles and cord connectors that have grounding contacts shall have those contacts effectively grounded.

*Exception No. 1: Receptacles mounted on portable and vehicle-mounted generators in accordance with 250.34.*

*Exception No. 2: Replacement receptacles as permitted by 406.3(D).*

**(C) Methods of Grounding.** The grounding contacts of receptacles and cord connectors shall be grounded by connection to the equipment grounding conductor of the circuit supplying the receptacle or cord connector.

FPN: For installation requirements for the reduction of electrical noise, see 250.146(D).

The branch-circuit wiring method shall include or provide an equipment-grounding conductor to which the grounding contacts of the receptacle or cord connector shall be connected.

FPN No. 1: 250.118 describes acceptable grounding means.

FPN No. 2: For extensions of existing branch circuits, see 250.130.

**(D) Replacements.** Replacement of receptacles shall comply with 406.3(D)(1), (2), and (3) as applicable.

**(1) Grounding-Type Receptacles.** Where a grounding means exists in the receptacle enclosure or a grounding conductor is installed in accordance with 250.130(C), grounding-type receptacles shall be used and shall be connected to the grounding conductor in accordance with 406.3(C) or 250.130(C).

**(2) Ground-Fault Circuit Interrupters.** Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

**(3) Nongrounding-Type Receptacles.** Where grounding means does not exist in the receptacle enclosure, the installation shall comply with (a), (b), or (c).

(a) A nongrounding-type receptacle(s) shall be permitted to be replaced with another nongrounding-type receptacle(s).

(b) A nongrounding-type receptacle(s) shall be permitted to be replaced with a ground-fault circuit interrupter-type of receptacle(s). These receptacles shall be marked "No Equipment Ground." An equipment grounding conductor shall not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle.

(c) A nongrounding-type receptacle(s) shall be permitted to be replaced with a grounding-type receptacle(s) where supplied through a ground-fault circuit interrupter. Grounding-type receptacles supplied through the ground-fault circuit interrupter shall be marked "GFCI Protected" and "No Equipment Ground." An equipment grounding conductor shall not be connected between the grounding-type receptacles.

**(E) Cord-and-Plug-Connected Equipment.** The installation of grounding-type receptacles shall not be used as a requirement that all cord-and-plug-connected equipment be of the grounded type.

FPN: See 250.114 for types of cord-and-plug-connected equipment to be grounded.

**(F) Noninterchangeable Types.** Receptacles connected to circuits that have different voltages, frequencies, or types of current (ac or dc) on the same premises shall be of such design that the attachment plugs used on these circuits are not interchangeable.

**406.4 Receptacle Mounting.** Receptacles shall be mounted in boxes or assemblies designed for the purpose, and such boxes or assemblies shall be securely fastened in place.

**(A) Boxes That Are Set Back.** Receptacles mounted in boxes that are set back of the wall surface, as permitted in 314.20, shall be installed so that the mounting yoke or strap of the receptacle is held rigidly at the surface of the wall.

**(B) Boxes That Are Flush.** Receptacles mounted in boxes that are flush with the wall surface or project therefrom shall be installed so that the mounting yoke or strap of the receptacle is held rigidly against the box or raised box cover.

**(C) Receptacles Mounted on Covers.** Receptacles mounted to and supported by a cover shall be held rigidly against the cover by more than one screw or shall be a device assembly or box cover listed and identified for securing by a single screw.

**(D) Position of Receptacle Faces.** After installation, receptacle faces shall be flush with or project from faceplates of insulating material and shall project a minimum of 0.4 mm (0.015 in.) from metal faceplates.

(E) **Receptacles in Countertops and Similar Work Surfaces in Dwelling Units.** Receptacles shall not be installed in a face-up position in countertops or similar work surfaces.

(F) **Exposed Terminals.** Receptacles shall be enclosed so that live wiring terminals are not exposed to contact.

**406.5 Receptacle Faceplates (Cover Plates).** Receptacle faceplates shall be installed so as to completely cover the opening and seat against the mounting surface.

(A) Metal faceplates shall be of ferrous metal not less than 0.76 mm (0.030 in.) in thickness or of nonferrous metal not less than 1.02 mm (0.040 in.) in thickness.

(B) Metal faceplates shall be grounded.

(C) Faceplates of insulating material shall be noncombustible and not less than 2.54 mm (0.10 in.) in thickness but shall be permitted to be less than 2.54 mm (0.10 in.) in thickness if formed or reinforced to provide adequate mechanical strength.

**406.6 Attachment Plugs.** All attachment plugs and cord connectors shall be listed for the purpose and marked with the manufacturer's name or identification and voltage and ampere ratings.

(A) Attachment plugs and cord connectors shall be constructed so that there are no exposed current-carrying parts except the prongs, blades, or pins. The cover for wire terminations shall be a part that is essential for the operation of an attachment plug or connector (dead-front construction).

(B) Attachment plugs shall be installed so that their prongs, blades, or pins are not energized unless inserted into an energized receptacle. No receptacle shall be installed so as to require an energized attachment plug as its source of supply.

(C) **Attachment Plug Ejector Mechanisms.** Attachment plug ejector mechanisms shall not adversely affect engagement of the blades of the attachment plug with the contacts of the receptacle.

**406.7 Noninterchangeability.** Receptacles, cord connectors, and attachment plugs shall be constructed so that receptacle or cord connectors do not accept an attachment plug with a different voltage or current rating from that for which the device is intended. However, a 20-ampere T-slot receptacle or cord connector shall be permitted to accept a 15-ampere attachment plug of the same voltage rating. Non-grounding-type receptacles and connectors shall not accept grounding-type attachment plugs.

#### **406.8 Receptacles in Damp or Wet Locations.**

(A) **Damp Locations.** A receptacle installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

An installation suitable for wet locations shall also be considered suitable for damp locations.

A receptacle shall be considered to be in a location protected from the weather where located under roofed open porches, canopies, marquees, and the like, and will not be subjected to a beating rain or water runoff.

#### **(B) Wet Locations.**

(1) **15- and 20-Ampere Outdoor Receptacles.** 15- and 20-ampere, 125- and 250-volt receptacles installed outdoors in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted.

(2) **Other Receptacles.** All other receptacles installed in a wet location shall comply with (a) or (b):

(a) A receptacle installed in a wet location where the product intended to be plugged into it is not attended while in use (e.g., sprinkler system controller, landscape lighting, holiday lights, and so forth) shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(b) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (e.g., portable tools, and so forth) shall have an enclosure that is weatherproof when the attachment plug is removed.

(C) **Bathtub and Shower Space.** A receptacle shall not be installed within a bathtub or shower space.

(D) **Protection for Floor Receptacles.** Standpipes of floor receptacles shall allow floor-cleaning equipment to be operated without damage to receptacles.

(E) **Flush Mounting with Faceplate.** The enclosure for a receptacle installed in an outlet box flush-mounted on a wall surface shall be made weatherproof by means of a weatherproof faceplate assembly that provides a watertight connection between the plate and the wall surface.

#### **406.9 Grounding-Type Receptacles, Adapters, Cord Connectors, and Attachment Plugs.**

(A) **Grounding Poles.** Grounding-type receptacles, cord connectors, and attachment plugs shall be provided with one fixed grounding pole in addition to the circuit poles. The grounding contacting pole of grounding-type plug-in

ground-fault circuit interrupters shall be permitted to be of the movable, self-restoring type on circuits operating at not over 150 volts between any two conductors or any conductor and ground.

**(B) Grounding-Pole Identification.** Grounding-type receptacles, adapters, cord connections, and attachment plugs shall have a means for connection of a grounding conductor to the grounding pole.

A terminal for connection to the grounding pole shall be designated by one of the following:

- (1) A green-colored hexagonal-headed or -shaped terminal screw or nut, not readily removable.
- (2) A green-colored pressure wire connector body (a wire barrel).
- (3) A similar green-colored connection device, in the case of adapters. The grounding terminal of a grounding adapter shall be a green-colored rigid ear, lug, or similar device. The grounding connection shall be designed so that it cannot make contact with current-carrying parts of the receptacle, adapter, or attachment plug. The adapter shall be polarized.
- (4) If the terminal for the equipment grounding conductor is not visible, the conductor entrance hole shall be marked with the word *green* or *ground*, the letters G or GR, or the grounding symbol, as shown in Figure 406.9(B)(4), or otherwise identified by a distinctive green color. If the terminal for the equipment grounding conductor is readily removable, the area adjacent to the terminal shall be similarly marked.



Figure 406.9(B)(4) Grounding symbol.

**(C) Grounding Terminal Use.** A grounding terminal or grounding-type device shall not be used for purposes other than grounding.

**(D) Grounding-Pole Requirements.** Grounding-type attachment plugs and mating cord connectors and receptacles shall be designed so that the grounding connection is made before the current-carrying connections. Grounding-type devices shall be designed so grounding poles of attachment plugs cannot be brought into contact with current-carrying parts of receptacles or cord connectors.

**(E) Use.** Grounding-type attachment plugs shall be used only with a cord having an equipment grounding conductor.

FPN: See 200.10(B) for identification of grounded conductor terminals.

**406.10 Connecting Receptacle Grounding Terminal to Box.** The connection of the receptacle grounding terminal shall comply with 250.146.

## ARTICLE 408 Switchboards and Panelboards

### I. General

**408.1 Scope.** This article covers the following:

- (1) All switchboards, panelboards, and distribution boards installed for the control of light and power circuits
- (2) Battery-charging panels supplied from light or power circuits

**408.2 Other Articles.** Switches, circuit breakers, and over-current devices used on switchboards, panelboards, and distribution boards, and their enclosures, shall comply with this article and also with the requirements of Articles 240, 250, 312, 314, 404, and other articles that apply. Switchboards and panelboards in hazardous (classified) locations shall comply with the requirements of Articles 500 through 517.

### 408.3 Support and Arrangement of Busbars and Conductors.

**(A) Conductors and Busbars on a Switchboard or Panelboard.** Conductors and busbars on a switchboard or panelboard shall comply with 408.3(A)(1), (2), and (3) as applicable.

**(1) Location.** Conductors and busbars shall be located so as to be free from physical damage and shall be held firmly in place.

**(2) Service Switchboards.** Barriers shall be placed in all service switchboards such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations.

**(3) Same Vertical Section.** Other than the required interconnections and control wiring, only those conductors that are intended for termination in a vertical section of a switchboard shall be located in that section.

*Exception: Conductors shall be permitted to travel horizontally through vertical sections of switchboards where such conductors are isolated from busbars by a barrier.*

**(B) Overheating and Inductive Effects.** The arrangement of busbars and conductors shall be such as to avoid overheating due to inductive effects.

**(C) Used as Service Equipment.** Each switchboard or panelboard, if used as service equipment, shall be provided with a main bonding jumper sized in accordance with 250.28(D) or the equivalent placed within the panelboard or one of the sections of the switchboard for connecting the

- (2) Inductive loads not exceeding 50 percent of the ampere rating of the switch at the applied voltage. Switches rated in horsepower are suitable for controlling motor loads within their rating at the voltage applied.
- (3) Tungsten-filament lamp loads not exceeding the ampere rating of the switch at the applied voltage if T-rated.

(C) **CO/ALR Snap Switches.** Snap switches rated 20 amperes or less directly connected to aluminum conductors shall be listed and marked CO/ALR.

(D) **Alternating-Current Specific-Use Snap Switches Rated for 347 Volts.** Snap switches rated 347 volts ac shall be listed and shall be used only for controlling the loads permitted by (D)(1) and (D)(2).

(1) **Noninductive Loads.** Noninductive loads other than tungsten-filament lamps not exceeding the ampere and voltage ratings of the switch.

(2) **Inductive Loads.** Inductive loads not exceeding the ampere and voltage ratings of the switch. Where particular load characteristics or limitations are specified as a condition of the listing, those restrictions shall be observed regardless of the ampere rating of the load.

The ampere rating of the switch shall not be less than 15 amperes at a voltage rating of 347 volts ac. Flush-type snap switches rated 347 volts ac shall not be readily interchangeable in box mounting with switches identified in 404.14(A) and 404.14(B).

(E) **Dimmer Switches.** General-use dimmer switches shall be used only to control permanently installed incandescent luminaires (lighting fixtures) unless listed for the control of other loads and installed accordingly.

## II. Construction Specifications

### 404.15 Marking.

(A) **Ratings.** Switches shall be marked with the current voltage, and, if horsepower rated, the maximum rating for which they are designed.

(B) **Off Indication.** Where in the off position, a switching device with a marked OFF position shall completely disconnect all ungrounded conductors to the load it controls.

**404.16 600-Volt Knife Switches.** Auxiliary contacts of a renewable or quick-break type or the equivalent shall be provided on all knife switches rated 600 volts and designed for use in breaking current over 200 amperes.

**404.17 Fused Switches.** A fused switch shall not have fuses in parallel except as permitted in 240.8.

**404.18 Wire-Bending Space.** The wire-bending space required by 404.3 shall meet Table 312.6(B) spacings to the enclosure wall opposite the line and load terminals.

## ARTICLE 406 Receptacles, Cord Connectors, and Attachment Plugs (Caps)

**406.1 Scope.** This article covers the rating, type, and installation of receptacles, cord connectors, and attachment plugs (cord caps).

### 406.2 Receptacle Rating and Type.

(A) **Receptacles.** Receptacles shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings.

(B) **Rating.** Receptacles and cord connectors shall be rated not less than 15 amperes, 125 volts, or 15 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

FPN: See 210.21(B) for receptacle ratings where installed on branch circuits.

(C) **Receptacles for Aluminum Conductors.** Receptacles rated 20 amperes or less and designed for the direct connection of aluminum conductors shall be marked CO/ALR.

(D) **Isolated Ground Receptacles.** Receptacles incorporating an isolated grounding connection intended for the reduction of electrical noise (electromagnetic interference) as permitted in 250.146(D) shall be identified by an orange triangle located on the face of the receptacle.

(1) **Isolated Equipment Grounding Conductor Required.** Receptacles so identified shall be used only with grounding conductors that are isolated in accordance with 250.146(D).

(2) **Installation in Nonmetallic Boxes.** Isolated ground receptacles installed in nonmetallic boxes shall be covered with a nonmetallic faceplate.

*Exception: Where an isolated ground receptacle is installed in a nonmetallic box, a metal faceplate shall be permitted if the box contains a feature or accessory that permits the effective grounding of the faceplate.*

**406.3 General Installation Requirements.** Receptacle outlets shall be located in branch circuits in accordance with Part III of Article 210. General installation requirements shall be in accordance with 406.3(A) through 406.3(F).

**(A) Grounding Type.** Receptacles installed on 15- and 20-ampere branch circuits shall be of the grounding type. Grounding-type receptacles shall be installed only on circuits of the voltage class and current for which they are rated, except as provided in Table 210.21(B)(2) and Table 210.21(B)(3).

*Exception:* Nongrounding-type receptacles installed in accordance with 406.3(D).

**(B) To Be Grounded.** Receptacles and cord connectors that have grounding contacts shall have those contacts effectively grounded.

*Exception No. 1:* Receptacles mounted on portable and vehicle-mounted generators in accordance with 250.34.

*Exception No. 2:* Replacement receptacles as permitted by 406.3(D).

**(C) Methods of Grounding.** The grounding contacts of receptacles and cord connectors shall be grounded by connection to the equipment grounding conductor of the circuit supplying the receptacle or cord connector.

FPN: For installation requirements for the reduction of electrical noise, see 250.146(D).

The branch-circuit wiring method shall include or provide an equipment-grounding conductor to which the grounding contacts of the receptacle or cord connector are connected.

FPN No. 1: See 250.118 for acceptable grounding means.

FPN No. 2: For extensions of existing branch circuits, see 250.130.

**(D) Replacements.** Replacement of receptacles shall comply with 406.3(D)(1), (D)(2), and (D)(3) as applicable.

**(1) Grounding-Type Receptacles.** Where a grounding means exists in the receptacle enclosure or a grounding conductor is installed in accordance with 250.130(C), grounding-type receptacles shall be used and shall be connected to the grounding conductor in accordance with 406.3(C) or 250.130(C).

**(2) Ground-Fault Circuit Interrupters.** Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this Code.

**(3) Non-grounding-Type Receptacles.** Where grounding means does not exist in the receptacle enclosure, the installation shall comply with (D)(3)(a), (D)(3)(b), or (D)(3)(c).

(a) A non-grounding-type receptacle(s) shall be permitted to be replaced with another non-grounding-type receptacle(s).

(b) A non-grounding-type receptacle(s) shall be permitted to be replaced with a ground-fault circuit interrupter-

type of receptacle(s). These receptacles shall be marked "No Equipment Ground." An equipment grounding conductor shall not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle.

(c) A non-grounding-type receptacle(s) shall be permitted to be replaced with a grounding-type receptacle(s) where supplied through a ground-fault circuit interrupter. Grounding-type receptacles supplied through the ground-fault circuit interrupter shall be marked "GFCI Protected" and "No Equipment Ground." An equipment grounding conductor shall not be connected between the grounding-type receptacles.

**(E) Cord-and-Plug-Connected Equipment.** The installation of grounding-type receptacles shall not be used as a requirement that all cord-and-plug-connected equipment be of the grounded type.

FPN: See 250.114 for types of cord-and-plug-connected equipment to be grounded.

**(F) Noninterchangeable Types.** Receptacles connected to circuits that have different voltages, frequencies, or types of current (ac or dc) on the same premises shall be of such design that the attachment plugs used on these circuits are not interchangeable.

**406.4 Receptacle Mounting.** Receptacles shall be mounted in boxes or assemblies designed for the purpose, and such boxes or assemblies shall be securely fastened in place unless otherwise permitted elsewhere in this Code.

**(A) Boxes That Are Set Back.** Receptacles mounted in boxes that are set back from the finished surface as permitted in 314.20 shall be installed such that the mounting yoke or strap of the receptacle is held rigidly at the finished surface.

**(B) Boxes That Are Flush.** Receptacles mounted in boxes that are flush with the finished surface or project therefrom shall be installed such that the mounting yoke or strap of the receptacle is held rigidly against the box or box cover.

**(C) Receptacles Mounted on Covers.** Receptacles mounted to and supported by a cover shall be held rigidly against the cover by more than one screw or shall be a device assembly or box cover listed and identified for securing by a single screw.

**(D) Position of Receptacle Faces.** After installation, receptacle faces shall be flush with or project from faceplates of insulating material and shall project a minimum of 0.4 mm (0.015 in.) from metal faceplates.

*Exception No. 1:* Listed kits or assemblies encompassing receptacles and nonmetallic faceplates that cover the receptacle face, where the plate cannot be installed on any other receptacle, shall be permitted.

*Exception No. 2:* Listed nonmetallic faceplates that cover the receptacle face to a maximum thickness of 1 mm (0.040 in.) shall be permitted.

**(E) Receptacles in Countertops and Similar Work Surfaces in Dwelling Units.** Receptacles shall not be installed in a face-up position in countertops or similar work surfaces.

**(F) Exposed Terminals.** Receptacles shall be enclosed so that live wiring terminals are not exposed to contact.

**406.5 Receptacle Faceplates (Cover Plates).** Receptacle faceplates shall be installed so as to completely cover the opening and seat against the mounting surface.

**(A) Thickness of Metal Faceplates.** Metal faceplates shall be of ferrous metal not less than 0.76 mm (0.030 in.) in thickness or of nonferrous metal not less than 1.02 mm (0.040 in.) in thickness.

**(B) Grounding.** Metal faceplates shall be grounded.

**(C) Faceplates of Insulating Material.** Faceplates of insulating material shall be noncombustible and not less than 2.54 mm (0.10 in.) in thickness but shall be permitted to be less than 2.54 mm (0.10 in.) in thickness if formed or reinforced to provide adequate mechanical strength.

**406.6 Attachment Plugs, Cord Connectors, and Flanged Surface Devices.** All attachment plugs, cord connectors, and flanged surface devices (inlets and outlets) shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings.

**(A) Construction of Attachment Plugs and Cord Connectors.** Attachment plugs and cord connectors shall be constructed so that there are no exposed current-carrying parts except the prongs, blades, or pins. The cover for wire terminations shall be a part that is essential for the operation of an attachment plug or connector (dead-front construction).

**(B) Connection of Attachment Plugs.** Attachment plugs shall be installed so that their prongs, blades, or pins are not energized unless inserted into an energized receptacle. No receptacle shall be installed so as to require the insertion of an energized attachment plug as its source of supply.

**(C) Attachment Plug Ejector Mechanisms.** Attachment plug ejector mechanisms shall not adversely affect engagement of the blades of the attachment plug with the contacts of the receptacle.

**(D) Flanged Surface Inlet.** A flanged surface inlet shall be installed such that the prongs, blades, or pins are not energized unless an energized cord connector is inserted into it.

**406.7 Noninterchangeability.** Receptacles, cord connectors, and attachment plugs shall be constructed such that receptacle or cord connectors do not accept an attachment plug with a different voltage or current rating from that for which the device is intended. However, a 20-ampere T-slot

receptacle or cord connector shall be permitted to accept a 15-ampere attachment plug of the same voltage rating. Non-grounding-type receptacles and connectors shall not accept grounding-type attachment plugs.

#### 406.8 Receptacles in Damp or Wet Locations.

**(A) Damp Locations.** A receptacle installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

An installation suitable for wet locations shall also be considered suitable for damp locations.

A receptacle shall be considered to be in a location protected from the weather where located under roofed open porches, canopies, marquees, and the like, and will not be subjected to a beating rain or water runoff.

#### (B) Wet Locations.

**(1) 15- and 20-Ampere Receptacles in a Wet Location.** 15- and 20-ampere, 125- and 250-volt receptacles installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted.

**(2) Other Receptacles.** All other receptacles installed in a wet location shall comply with (B)(2)(a) or (B)(2)(b).

(a) A receptacle installed in a wet location, where the product intended to be plugged into it is not attended while in use, shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(b) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (e.g., portable tools) shall have an enclosure that is weatherproof when the attachment plug is removed.

**(C) Bathtub and Shower Space.** Receptacles shall not be installed within or directly over a bathtub or shower stall.

**(D) Protection for Floor Receptacles.** Standpipes of floor receptacles shall allow floor-cleaning equipment to be operated without damage to receptacles.

**(E) Flush Mounting with Faceplate.** The enclosure for a receptacle installed in an outlet box flush-mounted in a finished surface shall be made weatherproof by means of a weatherproof faceplate assembly that provides a watertight connection between the plate and the finished surface.

#### 406.9 Grounding-Type Receptacles, Adapters, Cord Connectors, and Attachment Plugs.

**(A) Grounding Poles.** Grounding-type receptacles, cord connectors, and attachment plugs shall be provided with one fixed grounding pole in addition to the circuit poles. The grounding contacting pole of grounding-type plug-in

ground-fault circuit interrupters shall be permitted to be of the movable, self-restoring type on circuits operating at not over 150 volts between any two conductors or any conductor and ground.

**(B) Grounding-Pole Identification.** Grounding-type receptacles, adapters, cord connections, and attachment plugs shall have a means for connection of a grounding conductor to the grounding pole.

A terminal for connection to the grounding pole shall be designated by one of the following:

- (1) A green-colored hexagonal-headed or -shaped terminal screw or nut, not readily removable.
- (2) A green-colored pressure wire connector body (a wire barrel).
- (3) A similar green-colored connection device, in the case of adapters. The grounding terminal of a grounding adapter shall be a green-colored rigid ear, lug, or similar device. The grounding connection shall be so designed that it cannot make contact with current-carrying parts of the receptacle, adapter, or attachment plug. The adapter shall be polarized.
- (4) If the terminal for the grounding conductor is not visible, the conductor entrance hole shall be marked with the word *green* or *ground*, the letters *G* or *GR*, a grounding symbol, or otherwise identified by a distinctive green color. If the terminal for the equipment grounding conductor is readily removable, the area adjacent to the terminal shall be similarly marked.

FPN: See FPN Figure 406.9(B)(4).



FPN Figure 406.9(B)(4) One Example of a Symbol Used to Identify the Termination Point for an Equipment Grounding Conductor.

**(C) Grounding Terminal Use.** A grounding terminal or grounding-type device shall not be used for purposes other than grounding.

**(D) Grounding-Pole Requirements.** Grounding-type attachment plugs and mating cord connectors and receptacles shall be designed such that the grounding connection is made before the current-carrying connections. Grounding-type devices shall be so designed that grounding poles of attachment plugs cannot be brought into contact with current-carrying parts of receptacles or cord connectors.

**(E) Use.** Grounding-type attachment plugs shall be used only with a cord having an equipment grounding conductor.

FPN: See 200.10(B) for identification of grounded conductor terminals.

**406.10 Connecting Receptacle Grounding Terminal to Box.** The connection of the receptacle grounding terminal shall comply with 250.146.

## ARTICLE 408

### Switchboards and Panelboards

#### I. General

**408.1 Scope.** This article covers the following:

- (1) All switchboards, panelboards, and distribution boards installed for the control of light and power circuits
- (2) Battery-charging panels supplied from light or power circuits

**408.2 Other Articles.** Switches, circuit breakers, and over-current devices used on switchboards, panelboards, and distribution boards, and their enclosures shall comply with this article and also with the requirements of Articles 240, 250, 312, 314, 404, and other articles that apply. Switchboards and panelboards in hazardous (classified) locations shall comply with the requirements of Articles 500 through 517.

#### 408.3 Support and Arrangement of Busbars and Conductors.

**(A) Conductors and Busbars on a Switchboard or Panelboard.** Conductors and busbars on a switchboard or panelboard shall comply with 408.3(A)(1), (A)(2), and (A)(3) as applicable.

**(1) Location.** Conductors and busbars shall be located so as to be free from physical damage and shall be held firmly in place.

**(2) Service Switchboards.** Barriers shall be placed in all service switchboards such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations.

**(3) Same Vertical Section.** Other than the required interconnections and control wiring, only those conductors that are intended for termination in a vertical section of a switchboard shall be located in that section.

*Exception: Conductors shall be permitted to travel horizontally through vertical sections of switchboards where such conductors are isolated from busbars by a barrier.*

**(B) Overheating and Inductive Effects.** The arrangement of busbars and conductors shall be such as to avoid overheating due to inductive effects.

- (1) Resistive and inductive loads, including electric-discharge lamps, not exceeding the ampere rating of the switch at the voltage involved
- (2) Tungsten-filament lamp loads not exceeding the ampere rating of the switch at 120 volts
- (3) Motor loads not exceeding 80 percent of the ampere rating of the switch at its rated voltage

**(B) Alternating-Current or Direct-Current General-Use Snap Switch.** A form of general-use snap switch suitable for use on either ac or dc circuits for controlling the following:

- (1) Resistive loads not exceeding the ampere rating of the switch at the voltage applied.
- (2) Inductive loads not exceeding 50 percent of the ampere rating of the switch at the applied voltage. Switches rated in horsepower are suitable for controlling motor loads within their rating at the voltage applied.
- (3) Tungsten-filament lamp loads not exceeding the ampere rating of the switch at the applied voltage if T-rated.

**(C) CO/ALR Snap Switches.** Snap switches rated 20 amperes or less directly connected to aluminum conductors shall be listed and marked CO/ALR.

**(D) Alternating-Current Specific-Use Snap Switches Rated for 347 Volts.** Snap switches rated 347 volts ac shall be listed and shall be used only for controlling the loads permitted by (D)(1) and (D)(2).

**(1) Noninductive Loads.** Noninductive loads other than tungsten-filament lamps not exceeding the ampere and voltage ratings of the switch.

**(2) Inductive Loads.** Inductive loads not exceeding the ampere and voltage ratings of the switch. Where particular load characteristics or limitations are specified as a condition of the listing, those restrictions shall be observed regardless of the ampere rating of the load.

The ampere rating of the switch shall not be less than 15 amperes at a voltage rating of 347 volts ac. Flush-type snap switches rated 347 volts ac shall not be readily interchangeable in box mounting with switches identified in 404.14(A) and (B).

**(E) Dimmer Switches.** General-use dimmer switches shall be used only to control permanently installed incandescent luminaires unless listed for the control of other loads and installed accordingly.

## II. Construction Specifications

### 404.15 Marking.

**(A) Ratings.** Switches shall be marked with the current, voltage, and, if horsepower rated, the maximum rating for which they are designed.

**(B) Off Indication.** Where in the off position, a switching device with a marked OFF position shall completely disconnect all ungrounded conductors to the load it controls.

**404.16 600-Volt Knife Switches.** Auxiliary contacts of a renewable or quick-break type or the equivalent shall be provided on all knife switches rated 600 volts and designed for use in breaking current over 200 amperes.

**404.17 Fused Switches.** A fused switch shall not have fuses in parallel except as permitted in 240.8.

**404.18 Wire-Bending Space.** The wire-bending space required by 404.3 shall meet Table 312.6(B) spacings to the enclosure wall opposite the line and load terminals.

## ARTICLE 406

### Receptacles, Cord Connectors, and Attachment Plugs (Caps)

**406.1 Scope.** This article covers the rating, type, and installation of receptacles, cord connectors, and attachment plugs (cord caps).

#### 406.2 Receptacle Rating and Type.

**(A) Receptacles.** Receptacles shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings.

**(B) Rating.** Receptacles and cord connectors shall be rated not less than 15 amperes, 125 volts, or 15 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

FPN: See 210.21(B) for receptacle ratings where installed on branch circuits.

**(C) Receptacles for Aluminum Conductors.** Receptacles rated 20 amperes or less and designed for the direct connection of aluminum conductors shall be marked CO/ALR.

**(D) Isolated Ground Receptacles.** Receptacles incorporating an isolated grounding conductor connection intended for the reduction of electrical noise (electromagnetic interference) as permitted in 250.146(D) shall be identified by an orange triangle located on the face of the receptacle.

**(1) Isolated Equipment Grounding Conductor Required.** Receptacles so identified shall be used only with equipment grounding conductors that are isolated in accordance with 250.146(D).

**(2) Installation in Nonmetallic Boxes.** Isolated ground receptacles installed in nonmetallic boxes shall be covered with a nonmetallic faceplate.

*Exception: Where an isolated ground receptacle is installed in a nonmetallic box, a metal faceplate shall be permitted if the box contains a feature or accessory that permits the effective grounding of the faceplate.*

**406.3 General Installation Requirements.** Receptacle outlets shall be located in branch circuits in accordance with Part III of Article 210. General installation requirements shall be in accordance with 406.3(A) through (F).

**(A) Grounding Type.** Receptacles installed on 15- and 20-ampere branch circuits shall be of the grounding type. Grounding-type receptacles shall be installed only on circuits of the voltage class and current for which they are rated, except as provided in Table 210.21(B)(2) and Table 210.21(B)(3).

*Exception: Nongrounding-type receptacles installed in accordance with 406.3(D).*

**(B) To Be Grounded.** Receptacles and cord connectors that have equipment grounding conductor contacts shall have those contacts connected to an equipment grounding conductor.

*Exception No. 1: Receptacles mounted on portable and vehicle-mounted generators in accordance with 250.34.*

*Exception No. 2: Replacement receptacles as permitted by 406.3(D).*

**(C) Methods of Grounding.** The equipment grounding conductor contacts of receptacles and cord connectors shall be grounded by connection to the equipment grounding conductor of the circuit supplying the receptacle or cord connector.

FPN: For installation requirements for the reduction of electrical noise, see 250.146(D).

The branch-circuit wiring method shall include or provide an equipment grounding conductor to which the equipment grounding conductor contacts of the receptacle or cord connector are connected.

FPN No. 1: See 250.118 for acceptable grounding means.

FPN No. 2: For extensions of existing branch circuits, see 250.130.

**(D) Replacements.** Replacement of receptacles shall comply with 406.3(D)(1), (D)(2), and (D)(3) as applicable.

**(1) Grounding-Type Receptacles.** Where a grounding means exists in the receptacle enclosure or an equipment grounding conductor is installed in accordance with 250.130(C), grounding-type receptacles shall be used and

shall be connected to the equipment grounding conductor in accordance with 406.3(C) or 250.130(C).

**(2) Ground-Fault Circuit Interrupters.** Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this Code.

**(3) Non-Grounding-Type Receptacles.** Where attachment to an equipment grounding conductor does not exist in the receptacle enclosure, the installation shall comply with (D)(3)(a), (D)(3)(b), or (D)(3)(c).

(a) A non-grounding-type receptacle(s) shall be permitted to be replaced with another non-grounding-type receptacle(s).

(b) A non-grounding-type receptacle(s) shall be permitted to be replaced with a ground-fault circuit interrupter-type of receptacle(s). These receptacles shall be marked "No Equipment Ground." An equipment grounding conductor shall not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle.

(c) A non-grounding-type receptacle(s) shall be permitted to be replaced with a grounding-type receptacle(s) where supplied through a ground-fault circuit interrupter. Grounding-type receptacles supplied through the ground-fault circuit interrupter shall be marked "GFCI Protected" and "No Equipment Ground." An equipment grounding conductor shall not be connected between the grounding-type receptacles.

**(E) Cord-and-Plug-Connected Equipment.** The installation of grounding-type receptacles shall not be used as a requirement that all cord-and-plug-connected equipment be of the grounded type.

FPN: See 250.114 for types of cord-and-plug-connected equipment to be grounded.

**(F) Noninterchangeable Types.** Receptacles connected to circuits that have different voltages, frequencies, or types of current (ac or dc) on the same premises shall be of such design that the attachment plugs used on these circuits are not interchangeable.

**406.4 Receptacle Mounting.** Receptacles shall be mounted in boxes or assemblies designed for the purpose, and such boxes or assemblies shall be securely fastened in place unless otherwise permitted elsewhere in this Code.

**(A) Boxes That Are Set Back.** Receptacles mounted in boxes that are set back from the finished surface as permitted in 314.20 shall be installed such that the mounting yoke or strap of the receptacle is held rigidly at the finished surface.

**(B) Boxes That Are Flush.** Receptacles mounted in boxes that are flush with the finished surface or project therefrom

shall be installed such that the mounting yoke or strap of the receptacle is held rigidly against the box or box cover.

**(C) Receptacles Mounted on Covers.** Receptacles mounted to and supported by a cover shall be held rigidly against the cover by more than one screw or shall be a device assembly or box cover listed and identified for securing by a single screw.

**(D) Position of Receptacle Faces.** After installation, receptacle faces shall be flush with or project from faceplates of insulating material and shall project a minimum of 0.4 mm (0.015 in.) from metal faceplates.

*Exception: Listed kits or assemblies encompassing receptacles and nonmetallic faceplates that cover the receptacle face, where the plate cannot be installed on any other receptacle, shall be permitted.*

**(E) Receptacles in Countertops and Similar Work Surfaces in Dwelling Units.** Receptacles shall not be installed in a face-up position in countertops or similar work surfaces.

**(F) Exposed Terminals.** Receptacles shall be enclosed so that live wiring terminals are not exposed to contact.

*W 008*  
**(G) Voltage Between Adjacent Devices.** A receptacle shall not be grouped or ganged in enclosures with other receptacles, snap switches, or similar devices, unless they are arranged so that the voltage between adjacent devices does not exceed 300 volts, or unless they are installed in enclosures equipped with identified, securely installed barriers between adjacent devices.

**406.5 Receptacle Faceplates (Cover Plates).** Receptacle faceplates shall be installed so as to completely cover the opening and seat against the mounting surface.

**(A) Thickness of Metal Faceplates.** Metal faceplates shall be of ferrous metal not less than 0.76 mm (0.030 in.) in thickness or of nonferrous metal not less than 1.02 mm (0.040 in.) in thickness.

**(B) Grounding.** Metal faceplates shall be grounded.

**(C) Faceplates of Insulating Material.** Faceplates of insulating material shall be noncombustible and not less than 2.54 mm (0.10 in.) in thickness but shall be permitted to be less than 2.54 mm (0.10 in.) in thickness if formed or reinforced to provide adequate mechanical strength.

**406.6 Attachment Plugs, Cord Connectors, and Flanged Surface Devices.** All attachment plugs, cord connectors, and flanged surface devices (inlets and outlets) shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings.

**(A) Construction of Attachment Plugs and Cord Connectors.** Attachment plugs and cord connectors shall be constructed so that there are no exposed current-carrying parts except the prongs, blades, or pins. The cover for wire terminations shall be a part that is essential for the operation of an attachment plug or connector (dead-front construction).

**(B) Connection of Attachment Plugs.** Attachment plugs shall be installed so that their prongs, blades, or pins are not energized unless inserted into an energized receptacle or cord connectors. No receptacle shall be installed so as to require the insertion of an energized attachment plug as its source of supply.

**(C) Attachment Plug Ejector Mechanisms.** Attachment plug ejector mechanisms shall not adversely affect engagement of the blades of the attachment plug with the contacts of the receptacle.

**(D) Flanged Surface Inlet.** A flanged surface inlet shall be installed such that the prongs, blades, or pins are not energized unless an energized cord connector is inserted into it.

**406.7 Noninterchangeability.** Receptacles, cord connectors, and attachment plugs shall be constructed such that receptacle or cord connectors do not accept an attachment plug with a different voltage or current rating from that for which the device is intended. However, a 20-ampere T-slot receptacle or cord connector shall be permitted to accept a 15-ampere attachment plug of the same voltage rating. Non-grounding-type receptacles and connectors shall not accept grounding-type attachment plugs.

**406.8 Receptacles in Damp or Wet Locations.**

**(A) Damp Locations.** A receptacle installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

An installation suitable for wet locations shall also be considered suitable for damp locations.

A receptacle shall be considered to be in a location protected from the weather where located under roofed open porches, canopies, marquees, and the like, and will not be subjected to a beating rain or water runoff. All 15- and 20-ampere, 125- and 250-volt nonlocking receptacles shall be a listed weather-resistant type.

**FPN:** The types of receptacles covered by this requirement are identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2002, National Electrical Manufacturers Association Standard for Dimensions of Attachment Plugs and Receptacles.

**(B) Wet Locations.**

**(1) 15- and 20-Ampere Receptacles in a Wet Location.** 15- and 20-ampere, 125- and 250-volt receptacles installed

in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. All 15- and 20-ampere, 125- and 250-volt nonlocking receptacles shall be listed weather-resistant type.

**FPN:** The types of receptacles covered by this requirement are identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2002, National Electrical Manufacturers Association *Standard for Dimensions of Attachment Plugs and Receptacles*.]

*Exception: 15- and 20-ampere, 125- through 250-volt receptacles installed in a wet location and subject to routine high-pressure spray washing shall be permitted to have an enclosure that is weatherproof when the attachment plug is removed.*

**(2) Other Receptacles.** All other receptacles installed in a wet location shall comply with (B)(2)(a) or (B)(2)(b).

(a) A receptacle installed in a wet location, where the product intended to be plugged into it is not attended while in use, shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(b) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (e.g., portable tools) shall have an enclosure that is weatherproof when the attachment plug is removed.

**(C) Bathtub and Shower Space.** Receptacles shall not be installed within or directly over a bathtub or shower stall.

**(D) Protection for Floor Receptacles.** Standpipes of floor receptacles shall allow floor-cleaning equipment to be operated without damage to receptacles.

**(E) Flush Mounting with Faceplate.** The enclosure for a receptacle installed in an outlet box flush-mounted in a finished surface shall be made weatherproof by means of a weatherproof faceplate assembly that provides a watertight connection between the plate and the finished surface.

#### 406.9 Grounding-Type Receptacles, Adapters, Cord Connectors, and Attachment Plugs.

**(A) Grounding Poles.** Grounding-type receptacles, cord connectors, and attachment plugs shall be provided with one fixed grounding pole in addition to the circuit poles. The grounding contacting pole of grounding-type plug-in ground-fault circuit interrupters shall be permitted to be of the movable, self-restoring type on circuits operating at not over 150 volts between any two conductors or any conductor and ground.

**(B) Grounding-Pole Identification.** Grounding-type receptacles, adapters, cord connections, and attachment plugs shall have a means for connection of an equipment grounding conductor to the grounding pole.

A terminal for connection to the grounding pole shall be designated by one of the following:

- (1) A green-colored hexagonal-headed or -shaped terminal screw or nut, not readily removable.
- (2) A green-colored pressure wire connector body (a wire barrel).
- (3) A similar green-colored connection device, in the case of adapters. The grounding terminal of a grounding adapter shall be a green-colored rigid ear, lug, or similar device. The equipment grounding connection shall be so designed that it cannot make contact with current-carrying parts of the receptacle, adapter, or attachment plug. The adapter shall be polarized.
- (4) If the terminal for the equipment grounding conductor is not visible, the conductor entrance hole shall be marked with the word *green* or *ground*, the letters *G* or *GR*, a grounding symbol, or otherwise identified by a distinctive green color. If the terminal for the equipment grounding conductor is readily removable, the area adjacent to the terminal shall be similarly marked.

**FPN:** See FPN Figure 406.9(B)(4).



**FPN Figure 406.9(B)(4) One Example of a Symbol Used to Identify the Termination Point for an Equipment Grounding Conductor.**

**(C) Grounding Terminal Use.** A grounding terminal shall not be used for purposes other than grounding.

**(D) Grounding-Pole Requirements.** Grounding-type attachment plugs and mating cord connectors and receptacles shall be designed such that the equipment grounding connection is made before the current-carrying connections. Grounding-type devices shall be so designed that grounding poles of attachment plugs cannot be brought into contact with current-carrying parts of receptacles or cord connectors.

**(E) Use.** Grounding-type attachment plugs shall be used only with a cord having an equipment grounding conductor.

**FPN:** See 200.10(B) for identification of grounded conductor terminals.

**406.10 Connecting Receptacle Grounding Terminal to Box.** The connection of the receptacle grounding terminal shall comply with 250.146.

**406.11 Tamper-Resistant Receptacles in Dwelling Units.** In all areas specified in 210.52, all 125-volt, 15- and 20-ampere receptacles shall be listed tamper-resistant receptacles.

*Safety in the home.*

Support for SB 30

An Act Requiring the Revisions of the State Building Code  
to Incorporate Revisions to the National Electrical Code

	Name	City	State	Ele. License	Signature
1	Paul Costello	Hamden	CT	E1-122305	<i>Paul Costello</i>
2	Sean Daly	New Fairfield	CT	E2-159748	<i>Sean Daly</i>
3	WM BRUBERT	MIDDLETOWN	CT	E1-125433	<i>Wm Brubert</i>
4	Tom Aron	New Haven	CT	E2 0162068	<i>Tom Aron</i>
5	Richard E. Bette	East Haddam	CT	E2 083766	<i>Richard E. Bette</i>
6	Michael G. Gahagan	West Haven	CT	E1-124028	<i>Michael G. Gahagan</i>
7	Joseph R. Subowski	Guildford	CT	E1-103592	<i>Joseph R. Subowski</i>
8	Sal Distasio	Guildford	CT	103525-E1	<i>Sal Distasio</i>
9	NICHOLAS SACC	Guildford	CT	103568-E1	<i>Nicholas Sacco</i>
10	John O. O'Connell	Orange	CT	189535-E-2	<i>John O. O'Connell</i>
11	Thomas J. Vito	Hamden	CT	0102630 E1	<i>Thomas J. Vito</i>
12	Thomas H. Palmer	Middletown	CT	0152479 E2	<i>Thomas H. Palmer</i>
13	Donald R. O'Connor	North Branford	CT	0162667 E2	<i>Donald R. O'Connor</i>
14	John Deschamps	Manchester	CT	0157347 E2	<i>John Deschamps</i>
15	William Palmer	Willingford	CT	0154872 E2	<i>William Palmer</i>
16	ROBERT DE CAPRIO	N. BRANFORD	CT	0155711-E2	<i>Robert De Caprio</i>
17	Alfred Ercolani	Wallingford	CT	E10123707	<i>Alfred Ercolani</i>
18	Frank J. Zampare	Hamden	CT	0101006 E1	<i>Frank J. Zampare</i>
19	Donald Anthony	CHESHIRE	CT	E1-125132	<i>Donald Anthony</i>
20	Fred Bergman	Cheshire	CT	103069	<i>Fred Bergman</i>

**An Act Requiring the Revisions of the State Building Code  
to Incorporate Revisions to the National Electrical Code**

	Name	City	State	Ele. License	Signature
21	Kevin Munson	Plattsville	CT	0160350	<i>Kevin Munson</i>
22	Paul Mihal	Meriden	CT	121800	<i>Paul Mihal</i>
23	Ben Wessing	Meriden	CT	183647	<i>Ben Wessing</i>
24	William Dickey	Norwich	CT	0154227	<i>William Dickey</i>
25	Al Debusca	New Haven	CT	0154437	<i>Al Debusca</i>
26	Boyd Johnson	Wallingford	CT	E1 103354	<i>Boyd L. Johnson</i>
27	Daniel Cosgrove	Hamden	CT	E2-0192107	<i>Daniel Cosgrove</i>
28	Chet Ciampini	North Haven	CT	E2-0160486	<i>Chet Ciampini</i>
29	Dave Caplan	Guilford	CT	E2-0154391	<i>Dave Caplan</i>
30	Wm. T. Fitzgerald	Clinton	CT	E2-0153577	<i>Wm. T. Fitzgerald</i>
31	Lee Bailey	Cheshire	CT	E1-0122154	<i>Lee Bailey</i>
32	Robert Mordecai	Hamden	CT	E-2 - ELC-0154619	<i>Robert Mordecai</i>
33	Clifford O'Connell	Wallingford	CT	E1 003373-E1	<i>Clifford O'Connell</i>
34	Scott Flomondan	North Haven	CT	E2 0161677	<i>Scott Flomondan</i>
35	Michael Sorovich	Killingworth	CT	E1 121899	<i>Michael Sorovich</i>
36	Paul Cretz	Higganum	CT	E2 163164	<i>Paul Cretz</i>
37	JAIME CARABO	NORTH Branford	CT	E1 125776	<i>Jaime Carabo</i>
38	Dan Lipinski	New Britain	CT	E1 157209	<i>Dan Lipinski</i>
39	Charles Wischenbart	Southington	CT	E1 103060	<i>Charles Wischenbart</i>
40	Ricky J Massicott	Higganum	CT	E2 162464	<i>Ricky J Massicott</i>

# Support for SB 30

## An Act Requiring the Revisions of the State Building Code to Incorporate Revisions to the National Electrical Code

Name	City	State	Ele. License	Signature
41 Arthur W Stevens III	Branford	CT	186910	Arthur W Stevens III
42 Sim DeRiva	East Haven	CT	180119	Sim DeRiva
43 Chris Votto	Northford	CT	0122187	Chris Votto
44 Anthony Cartier	North Haven	CT	0157065	Anthony Cartier
45 Tony Chialastro	NORTH HAVEN	CT	E1-104869	Tony Chialastro
46 Thomas Ferraro	Gulfport	CT	E1-0122202	Thomas Ferraro
47 Paul Radowicki	West Haven	CT	E1-0103951	Paul Radowicki
48 Jeremiah Desanti, Jr.	Hamden	CT	E1-0125467	Jeremiah Desanti, Jr.
49 Gintee Schatz	Cheshire	CT	E1 0104654	Gintee Schatz
50 Theodore M Bohner	Cheshire	CT	E1-0180645	Theodore M Bohner
51 Jeffrey Kozimer	Wallingford	CT	E2-0159491	Jeffrey Kozimer
52 Anthony F. Amici	Wallingford	CT	E2-0155298	Anthony F. Amici
53 Craig A. Newell	Wallingford	CT	E2-0189850-E2	Craig A. Newell
54 Gary LASSINGER SR	GROTON	CT	E2-0155295	Gary LASSINGER SR
55 GARY K LASSINGER SR	GROTON	CT	E1-122164	GARY K LASSINGER SR
56 David L. Hale	GROTON	CT	E1-876192	David L. Hale
57 Michael J. Crisci	Hamden	CT	E1-123585	Michael J. Crisci
58 Gary D'AMORA	NORTH HAVEN	CT	E2-161645	Gary D'AMORA
59 Tim Acker	North Haven	CT	E-1 103254	Tim Acker
60 Ken Gracowski	Shelton	CT		Ken Gracowski

**An Act Requiring the Revisions of the State Building Code  
to Incorporate Revisions to the National Electrical Code**

	Name	City	State	Ele. License	Signature
61	Ac DeSina	Wallingford	CT	E-2 162160	<i>Cal W</i>
62	Mike Greco	Guildford	CT	E-1 121925	<i>Mike Greco</i>
63	Louis Brangi	East Haven	CT	E-2 155119	<i>Louis Brangi</i>
64	John Jgblonski	North Haven	CT	E-1 103970	<i>John Jgblonski</i>
65	Jimmy Waselton	Hamden	CT	E-2 163108	<i>Jimmy Waselton</i>
66	Scott Finkus	Guildford	CT	E-2 182735	<i>Scott Finkus</i>
67	Jack P. Tiboni	East Haven	CT	E-2 0161924	<i>Jack P. Tiboni</i>
68	John Cusumano Jr	Hamden	CT	0162436 - 2	<i>John Cusumano Jr</i>
69	Danny Barbato	Hamden	CT	163137 - 2	<i>Danny Barbato</i>
70	Robert J. Dwyer	Hamden	CT	E-1 192933	<i>Robert J. Dwyer</i>
71	Michael Doud	East Haven	CT	E-1 122248	<i>Michael Doud</i>
72	Brian Kirby	Hamden	CT	E-2 185380	<i>Brian Kirby</i>
73	Rich Smith	Milford	CT	E-1 180604	<i>Rich Smith</i>
74	Tom Dwyer	Nb. Haven	CT	E-1 189534	<i>Tom Dwyer</i>
75	Joe Spivill	New Haven	CT	E-2 193415	<i>Joe Spivill</i>
76	Scott Olson	North Haven	CT	E-1 180579	<i>Scott Olson</i>
77	Joe Pannone	East Haven	CT	E-1 125098	<i>Joe Pannone</i>
78	Darryl Redding	East Haven	CT	E-1 185899	<i>Darryl Redding</i>
79	Donald Palmieri	Cheshire	CT	E-2 154200	<i>Donald Palmieri</i>
80	Gennaro Ruocco	East Haven	CT	ELC 0103960-EI	<i>Gennaro Ruocco</i>

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	Name	City	State	Ele. License	Signature
81	M. MIERZEL	Gulfport	CT	155389-E2	Jim. Mierzecki
82	James McNamee	Gulfport	CT	155225-E2	James McNamee
83	Frank Mc Donough	Maryland	CT	160052	
84	Mitchell Hammer	Gulfport	CT	103767	James McNamee
85	Joseph J. Montheir	Middlefield	CT	0163089-E2	Joe Montheir
86	Michael Taylor	West Haven	CT	0153955-E2	Michael Taylor
87	Daniel A. Fainer	Ansonia	CT	160581-E1	Daniel Fainer
88	Ken Swanson	Madison	CT	104646	Ken Swanson
89	Tom Fenton	Aresion	CT	122215 E-1	Tom Fenton
90	Harold Medina	Lebanon	CT	0190400-E2	Harold Medina
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